

network runs out of capacity, like during cell congestion. These dynamic operations may require use of new mechanisms and technologies.

[0021] 3GPP release 8 TS 23.402 describes ANDSF (Access Network Discovery and Selection Function) which provides an operator a tool to control how user devices move between mobile and Wi-Fi networks. ANDSF can be used to tell a specific user device/group of user devices to automatically connect to defined Wi-Fi networks when becoming available, thus providing an operator the tools to offload traffic to Wi-Fi and leave more resources on the mobile network to better serve mobile users. However, use of ANDSF alone by the operator may not be sufficient because, if a particular user does not have Wi-Fi access rights as part of the user's subscription, the user may not be able to be authenticated in a Wi-Fi network. Further, if a mobile network user profile (e.g. stored into home location register/home subscriber server/policy control rule function (HLR/HSS/PCRF)) denies Wi-Fi access for the user, Wi-Fi access may fail after authentication if the user traffic is integrated into a packet core and a gateway GPRS support node/packet data network gateway (GGSN/P-GW) via a gateway (GW) like tunnel termination gateway (TTG), enhanced packet data gateway (ePDG), or Access GW (MAG). In such a case, temporary allowance of Wi-Fi access in appropriate user profile(s) ensures all network elements involved in integrating Wi-Fi traffic to a packet core and GGSN/P-GW/alike operate fluently and do not reject the user.

[0022] Alternatively, an operator may configure an AAA server (by configuring an AAA server database, for example) to designate which users are able to have access to operator hotspots/defined Wi-Fi network areas. Such a configuration may take place, for example, when a user buys a data subscription with Wi-Fi access. However, at present, dynamic configuration may not be performed online on demand.

[0023] Typically, an operator bundles Wi-Fi usage, for example, to premium mobile data subscriptions for users. Users with these subscriptions may then be able to access operator hotspots. Other users may need to buy online access to operator hotspots, for example, using Captive portal (username/password inputted into a landing page) authentication.

[0024] Current hotspot authentication mechanisms do not support a strategy of efficient offloading to Wi-Fi when a mobile network, for example, begins to run out of resources because of too much traffic. One of the difficulties in efficient offloading to Wi-Fi is that, within a visibility area of a Wi-Fi network, there may only be a few premium data users with Wi-Fi hotspot access rights (subscriptions). Further, another difficulty is that most of the users with Wi-Fi capable devices may continue using the mobile network despite being able to access the Wi-Fi network. In order to be able to manage network congestion, there is a need for a tool that allows masses of users to be offloaded to a Wi-Fi network when necessary and then brought back to the mobile network later.

[0025] In view of the above, one embodiment is directed to a dynamic access rights management system for operators of Wi-Fi networks. In some embodiments, temporary access to operator Wi-Fi networks may be granted to users who do not normally have Wi-Fi access rights as part of, for example, their mobile data subscriptions. Otherwise, only users with subscriptions to a Wi-Fi network may normally access the Wi-Fi network. In some embodiments, Wi-Fi may be any

wireless local area network products that are based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards.

[0026] To ensure that user devices move to selected Wi-Fi networks, some embodiments may be coupled with a network selection tool, like 3GPP ANDSF (Access Network Discovery and Selection Function) or Hotspot 2.0 ANQP (Access Network Query Protocol). As such, operators are provided with an efficient tool to manage congestion situations in a mobile network and/or to improve user experience, as any number of users may be dynamically offloaded to nearby Wi-Fi networks.

[0027] Certain embodiments may select user(s) to be given temporary access rights to selected (or all) operator or operator roaming partner hotspots based on, for example:

[0028] An amount of congestion in a mobile cell, with the aim of reducing mobile cell load.

[0029] Factors necessary to support an adequate level of user experience, e.g. defined bitrates or quality of service (QoS).

[0030] Congestion or shortage of network resources on any other part of the mobile network (i.e., interface or network elements like GGSN/P-GW).

[0031] Use of defined applications by the user (detected with Deep Packet Inspection or the like), for example, use of video streaming or P2P.

[0032] If a user has certain type of mobile subscription and, for example, exceeds monthly quota, an operator grants Wi-Fi access and encourages the user to use Wi-Fi after the quota has been exceeded.

[0033] If a mobile network is malfunctioning or otherwise does not operate as targeted on some area, temporary access to Wi-Fi may be granted to fulfil service agreements

[0034] Certain embodiments also apply to non-mobile operators, like BT. For example BT may operate Wi-Fi hotspots with different service set identifiers (SSIDs) or service domains and, if a user is granted access to only one SSID (like BTOpenZone), temporary access can be granted dynamically to another BT SSID (like BT-VIP or BT-Stadium). The temporary access management may occur, for example, during a football game when a BTOpenZone load is heavy or as an online decision where a BT subscriber enters an area (like a shopping mall) and there is a campaign involving the subscriber requiring access to BT network resources (like SSID) that are not typically part of BT user subscription.

[0035] Certain embodiments may include the following functions which may use separate network elements integrated into existing network elements. Some of the functions may be combined and some of the functions omitted.

[0036] Certain embodiments may include a Wi-Fi Offload Manager in a mobile network that decides when to trigger traffic offload to a Wi-Fi network. The Wi-Fi Offload Manager may be located close to a base station/radio access network RRM (Radio Resource Manager) or within a monitoring/analysis platform or within a packet data network gateway/deep packet inspection (P-GW/DPI) etc. As such, the Wi-Fi Offload Manager may learn when congestion, or other defined criteria, occurs in a mobile network, whether users are using certain applications (e.g. video), and when users do not receive data at a targeted bit rate, for example.

[0037] FIG. 1 illustrates a method according to certain embodiments. At 100, the Wi-Fi Offload Manager may be